

The Contribution of Metacognitive Skills and Critical Thinking Skills on the Retention of Senior High School Students at Biology Learning Based on PBL in Malang, Indonesia

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Abstract: Retention is an important indicator of learning. There are various factors that can influence the level of the students' retention, including the metacognitive skills and critical thinking skills. This research aims at determining the amount of contribution of metacognitive skills and critical thinking skills simultaneously to students' retention at Biology learning based on PBL. This is a descriptive of correlational research. The population in this research is all class XI students of Senior High School in Malang at the first semester of the 2015/2016 academic year. The samples used in this research are the class XI students of Natural Science 2 of Senior High School 7 Malang consisting of 24 students, and the class XI students of Natural Science 4 of Senior High School 9 Malang consisting of 23 students. The data are analyzed by using multiple regression analysis. The results of the data analysis show that metacognitive skill give relative contribution as much as 95.05%, and the effective contribution as much as 35.83% towards retention, while the critical thinking skill gave relative contribution as much as 4.95% and effective contribution as much as 1.87% toward the retention at Biology learning implementing PBL.

Keywords: Biology learning, critical thinking skills, metacognitive skills, retention.

INTRODUCTION

In the learning activities, there are a wide range of important indicators that should be empowered, and one of which is retention. An increase of learning results can be seen from the retention of learning results [1]. The actual nature of learning is an internal process that includes memory, retention, information processing, emotions, and other factors based on previous experience [2]. Retention is influenced by several factors, including metacognitive skill and critical thinking skill.

Metacognitive skill is the skill possessed by each individual about learn how to learn or understand how to resolve issues / problems experienced by himself/herself in achieving a competency. Metacognition is ever described as "*cognition about cognitive phenomena*" or in a simpler way "*thinking about thinking*" [3]. Furthermore it has been known that metacognition leads to higher level thinking processes that involves the active control of cognitive processes [4].

In addition to metacognitive skill, critical thinking skill plays a role in determining the level of the students' retention. In this connection it is said that,

critical thinking skill is the process of using the mind to (1) search for meaning and understanding of a case that is seen, heard, remembered, or read, (2) make considerations and decisions, (3) solve problems [5]. There are six aspects of critical thinking skill and indicators [6]. The indicators and the aspects of critical thinking skill include formulating problems, giving arguments, making deduction, making induction, evaluating, and to deciding and implementing.

There have been many researches about multiple correlation related to metacognitive skill and critical thinking skill as predictors, and learning results as criterium. One of those researches is about the correlation between metacognitive skill and critical thinking skill with Biology learning results of the students taught by using *Problem Based Learning* (PBL) in class XI of senior high school in Malang [7]. The research showed that the effective contribution of metacognitive skills and critical thinking skill on biology learning results was 28.86% and 46.16% respectively. Another similar research shows that metacognitive skill has an effective contribution of 30.70% and critical thinking has an effective contribution of 41.99% on cognitive learning results in *reciprocal teaching* strategy [8]. On the other hand

there is also a research about the correlation between reading interest, metacognitive skills, and critical thinking skills to Biology learning results of the students taught by using *reading-concept map-Think Pair Share (TPS)* showing that metacognitive skill has an effective contribution of 74.09% and critical thinking skill has an effective contribution of 5.42% to cognitive learning results [9].

There have been many researches showing the linier correlation between metacognitive skill and retention or between critical thinking skill and retention in order to know the effective contribution of each of these variables on the retention. For example, there is a research related shows that there is a correlation between critical thinking skill and the retention in science and mathematics learning implementing *Peer-Led Team Learning (PLTL)* [10]. Another research shows that there is a correlation between metacognition skill and students' retention in Basic Biology lecture implementing PBL integrated with Jigsaw learning [11]. On the other hand, related to the predictor contribution there is a research showing that the contribution of the retention of metacognitive skill on the retention of learning results was 46,1% [12]. Furthermore another research about the correlation between metacognitive skills and the students' retention in Biology learning based on PBL in Senior high school in Malang shows that the effective contribution of metacognitive skill on the retention of learning results was 35.9% [13]. Related to the research variables, the research on the contribution of metacognitive skill and critical thinking skill simultaneously on the retention has never been conducted previously.

PBL learning strategy in biology learning has been proven having potency to empower metacognitive skills and biological concept gaining [14; 15; 16] and retention [17]. Therefore, it will be very useful to reveal the correlation between the contribution of metacognitive skill and critical thinking skill on students' retention in the biology learning which using PBL learning model.

The purpose of this research was to find out the contribution of metacognitive skills and critical

thinking skill to the retention of students' learning results in biology learning implementing *problem-based learning*. The results of this research are expected to be useful for the educational process namely as a mean to develop students' metacognitive skill and critical thinking skill which will have a positive effect on the their retention of learning results, and as a guide to improve the role of teachers as a facilitator, motivator and mediator in learning, to empower metacognitive skill and critical thinking skill through the implementation of *problem-based learning*.

RESEARCH METHOD

The design of this research was correlational research. This research was conducted at state senior high school 7 and state senior high school 9 Malang in the 2015/2016 academic year for ± 2 months. The population of this research was all students of class XI of senior high schools in Malang, while the samples were the students of class XI of natural science 2 of state senior high school 7 Malang consisting of 24 students and class XI of natural science 4 of state senior high school 9 Malang consisting 23 students.

The samples were selected by using *random sampling* technique. The learning materials used in this research included the syllabus, lesson plan, student worksheet, and tests. The instruments consisted of the rubric of metacognitive skills and the rubric of retention. The data were analyzed by using multiple regression analysis supported by *SPSS software for Windows 23* and performed at the 5% significance level.

RESULTS AND DISCUSSION

The results of the statistical test related to the correlation between metacognitive skill and critical thinking skill on students' retention of learning results can be seen in Table 1, 2 and 3. The results of the analysis in Table 1 show that the F value is 13.295 with the significance value of $0.000 < 0.05$. This means that metacognitive skill and critical thinking skill have a correlation with the retention. Furthermore, the result of the regression equation coefficient analysis in Table 2 show that the regression equation: $Y = 33\ 279 + 0321 X_1 + 0363 X_2$.

Table 1: Summary of the Results of Anova Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	903.041	2	451.520	13.295	,000 ^b
	Residual	1494.352	44	33.963		
	Total	2397.393	46			

Table 2: Summary of Regression Equation Coefficient Analysis

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	33,279	7,151		4,654	,000		
	KetMeta	,321	,310	,294	1,037	,305	,177	5,663
	KBKritis	,363	,307	,335	1,182	,244	,177	5,663

Table 3: Summary of multiple Regression Test Results

	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,614 ^a	,377	,348	5,82774

The summary of the results of multiple regression test on Table 3 shows that the contribution of the independent variable, namely the metacognitive skill and critical thinking skill on the dependent variable, namely the retention is 37.7% while the remaining part as much as 62.3% is influenced by the other variables not examined.

The results of this research are in line with a research conducted before showing that the contribution of metacognitive skill toward cognitive learning results was bigger than that critical thinking skill; the contribution of metacognitive skill was 74.09%, and the contribution of critical thinking skill was 5.42% [9]. It is also consistent with another research showing that the students' *self-regulation* skill, in this case related to the metacognitive skills, had an increased value of N-gain *habits of mind* higher than the indicators of *critical thinking* at the implementation of *Problem Based Learning* [16].

Metacognition leads to higher order thinking processes that involve the active control of cognition in the learning process [4]. Furthermore metacognition is the awareness of thinking, the awareness of the content of the concept and actively monitoring the cognitive process, trying to regulate the cognitive processes in relation to further learning, and applying effective components to help someone or himself in organizing methods for solving problems in general [18]. There are also opinion classifying the definition of metacognition based on the differences in their uses, namely (1) as knowledge about cognition and (2) as a control, a monitor, and a regulation of cognitive processes [19]. On the other hand there are also opinion stating that in general metacognitive skills were divided into two types: *self-assessment* or the skill to access their own cognition and *self-management* or the ability to manage their cognitive development [20].

Metacognitive skill enables students to be an independent learners, because it encourages the students to become the regulator of themselves and the assessor of their own thinking and learning [21]. The more the student are aware of their thinking process during their

learning, the more successful the students to control their purposes, personality, and attention [22]. Moreover, there are an explanation stating that the aspects of metacognitive skill are able to overcome learning difficulties [23]. Therefore, the students having high awareness of metacognitive skill will also have good thinking awareness, so that they can organize their learning patterns well, and they can understand the content of a concept appropriately. As a result, the information will be retained longer in their *long-term memory*, and ultimately will positively affect their retention.

In addition to metacognitive skill, critical thinking skill also has a contribution on retention. This result is consistent with the research results before showing that the implementation of *Peer-Led Team Learning* (PLTL) in the science and mathematics learning had a positive effect on critical thinking skills, and could eventually improve retention [10]. In fact, critical thinking skill is the ability to use cognitive strategies that can improve the probability of the achievement of the desired learning goals [24]. This process also involves solving problems, formulating influential factors, calculating various possibilities, and making a decision. There is an opinion saying that critical thinking skill involved the concepts of analyzing information, implementing strategies to make a decision, the readiness to consider ideas, using a logical investigation, obtaining evidence, testing conclusions, making appropriate decisions, and analyzing assumptions [25]. People who use their critical thinking will be able to identify problems, ask questions, deliver answers or arguments, and find other information [26]. Furthermore, another opinion stating that one purpose of critical thinking was to achieve a deeper understanding [27]. A good critical thinking skill will be able to encourage students to gain a deeper and more precise understanding, so that it can be stored longer in the memory which will eventually affect retention.

The effective contribution of metacognitive skill on the retention was 37.7%. This results is not consistent with the research results before related to the correlation between metacognitive skill and critical

thinking skill with biology learning results of Class XI students of Senior High School who learned by using *Problem Based Learning* (PBL) in Malang [7]. The results showed that the effective contribution of metacognitive skill and critical thinking skill on biology learning results was 28.86% and 46.16% respectively. Furthermore another research related to the implementation of *reciprocal teaching* strategy showed that the effective contribution of metacognitive skills and critical thinking skill on biology learning results was 30.70% and 41.99% respectively [8]. These results indicate that the contribution of metacognitive skills on biology learning results is smaller than that of critical thinking skill.

Each individual has different abilities in remembering, but every individual can improve their remembering ability by setting better conditions and using appropriate methods [28]. Thus, the ability to remember and retrieve the information, or so-called retention, is closely related to metacognitive skills where *self-regulating* plays an important role. This is in line with an explanation before stating that metacognitive skill takes parts in many types of cognitive activities which include understanding, communication, attention, memory, and problem solving [29].

The contribution of metacognitive skill and critical thinking skill toward retention cannot be separated from the role of the learning strategy implemented, namely the *Problem Based Learning*. This fact is in line with the research before showing that *Problem Based Learning* strategy had a significant effect on metacognitive skills and critical thinking skill [30]. The implementation of *Problem Based Learning* has five steps, namely, 1) orientating the students to the problems, 2) organizing the students to learn, 3) guiding the investigation, 4) developing and presenting the work, and 5) analyzing and evaluating the problem solving process [31]. Other reference states that *Problem Based Learning* can improve students' *self-regulation* through the provided case, the activity structure and discussion during the learning process as well as the support and reflection of the students in the learning process [32]. Furthermore, it has been revealed that *Problem Based Learning* could motivate students to learn the concepts and improved the students' self-regulation skill, so that they could learn independently [33].

Problem Based Learning helps students to develop their skills in learning, teamwork, and problem solving [34]. Furthermore, it is stated that *Problem Based Learning* was used to stimulate high order thinking in a problem-oriented situations, including learning how to learn [35]. The implementation of *Problem Based Learning* requires the students to

empower their metacognitive skills related to the pattern of learning, and critical thinking skill to solve the problems given by the teacher. The empowerment of metacognitive skills and critical thinking skill in the learning will eventually increase the students' retention because the students are directly and independently involved in seeking answers to the problems presented, so that the concepts gained will be stored better in their memory. This is consistent with the explanation that empowering critical thinking skill, including the metacognitive skill, has a positive effect on concept gaining and the increase of retention [17].

Learning with *Problem Based Learning* strategy can create a meaningful learning atmosphere for the students because the students are required to independently solve the problems presented by the teachers. A meaningful learning will be able to improve students' retention. This is in line with the opinion that the information which is meaningfully learned can retain longer in the memory than that learned by memorizing [36]. Furthermore, it is also stated that a person could store information on long-term memory not only in the form of facts, but also in the form of learning strategies, so that it could be easily remembered [37].

The results of this research show that the empowerment of metacognitive skill and critical thinking skill has a positive effect on students' retention. The purpose of a learning process is not only focused on the learning results, but more deeply to improve retention; the factors that determine the level of students' retention, such as metacognitive skill and critical thinking skill need to be continuously empowered in the learning process. The learning scheme that is able to empower students' metacognitive skill and critical thinking skill which have a positive effect on students' retention can be implemented through a variety of meaningful learning strategies, among other which require the students to solve problems, such as *Problem Based Learning*.

CONCLUSION

Metacognitive skill has a bigger contribution on retention than critical thinking skill does. The regression equation of metacognitive skills and critical thinking skill on retention is $Y = 33.279 + 0.321 X_1 + 0.363 X_2$ with the contribution of independent variables on the dependent variables as much as 37.7%, while the remaining contribution as much as 62.3% is contributed by other variables not examined. The effective contribution of metacognitive skill on the retention is 35.83% and the effective contribution of critical thinking skills on the retention is 1.87%. The value of the contribution of metacognitive skill and critical thinking skill on retention is determined too by the implementation of *Problem Based Learning* strategy.

The implementation of *Problem Based Learning* requires the students to organize their learning patterns independently in solving problems presented by the teachers, so that learning will be meaningful for students and their metacognitive skills and critical thinking skills will be honed. The empowerment of metacognitive skill and critical thinking skill in meaningful learning will further enhance students' understanding, so that the information is stored longer in their memory, and will ultimately have a positive effect on students' retention.

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